

THE DIRECTOR OF CENTRAL INTELLIGENCE

FILE COPY

WASHINGTON, D. C. 20505

National Intelligence Officers

SP - 55/78
24 February 1978

MEMORANDUM FOR:

[REDACTED]

, OSR
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FROM: National Intelligence Officer for Strategic Programs

SUBJECT: Discussion with Mr. Schwiller of House Armed Services
Committee Staff

1. This is to remind you that per agreement between the DCI and Congressman Stratton we are to meet with Mr. Schwiller in my office from 9-10 a.m. on Monday, 27 February. Purpose is to compare methodologies of NIE force comparisons and HAC study of counterforce capabilities. Schwiller was principal staffer on the HAC study.

2. Attached for your reference are copies of the HAC study and [REDACTED]
[REDACTED] analysis of it.

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3. I propose the following discussion topics:

a. Our approach and differences between it and HAC approach.

[REDACTED]

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b. Soviet silo conversion program [REDACTED]

[REDACTED]

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c. Multiple targeting against silos [REDACTED]

[REDACTED]

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4. Mr. Schwiller has SI and TK clearances.

[REDACTED]

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Howard Stoertz, Jr.

Attachments

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SP - 55/78

SUBJECT: Discussion with Mr. Schwiller of House Armed Services
Committee Staff

Distribution:

- 1 - [redacted] (OSR)
- 1 - [redacted] (OSR)
- 1 - [redacted] (OWI)
- 1 - NIO/SP
- 1 - NFAC Registry
- 1 - OLC (Attn: [redacted])
- 1 - Ch/CSS/NFAC

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23 February 1978

MEMORANDUM FOR: NIO/SP

SUBJECT : House Armed Services Committee Report;
Strategic Missile Counterforce Capability,
United States vs. The Soviet Union

1. This study, read into the Congressional Record by Representative Stratton on January 23, 1978, addressed itself to the following questions:

"Does the United States now possess a secure and survivable land-based intercontinental ballistic missile deterrent?

Could the United States, even in a first strike situation, destroy the land-based intercontinental ballistic missile capability of the Soviet Union in order to prevent a retaliation by those forces?

Could the Soviet Union in a first strike situation, destroy the land-based intercontinental missile forces of the United States so as to prevent a retaliation by those forces?"

2. The study was concerned only with the vulnerability of land-based ICBMs and, therefore, is not comparable to the residual analysis presented by the DCI to the House Armed Services Committee. Furthermore, only missiles, both ICBMs and SLBMs, were considered in the analysis and the large hard target potential of the US bomber force was not illustrated as in the NIE.

3. The principal findings of the study are:

"This study shows that the land-based intercontinental ballistic missile (ICBM) forces of the United States are vulnerable at this time and that they will become more

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vulnerable within the next four to five years as the accuracy of the Soviet ICBM's improves. A careful analysis shows that, if the entire available force of ICBM's and sea-launched ballistic missiles (SLBM) of the United States were to be targeted on 1,300 silos considered to be operational within the Soviet Union, at best about 16 percent of the Soviet missile silos would be put out of action by current U.S. systems. This percentage could increase to 68 percent by the 1980's only if the 550 MINUTEMAN III missiles are upgraded in accuracy and yield per current U.S. Air Force plans.

Conversely, the study shows that due to the high yields of Soviet missile warheads and the lack of sufficient hardening of the silos in the United States, the Soviet Union could put out of action a large fraction of all United States land-based ICBM's and still have a considerable percentage of its land-based missiles and all of its sea-based missile forces available for other targets."

4. Their conclusions about Minuteman vulnerability are generally consistent with the judgments in the NIE although many of the details are different. Differences in the methodology they used for analyzing silo vulnerability and the characteristics assumed for US and Soviet systems result in an assessment of Soviet ICBM vulnerability, however, which appears to be at odds with that contained in the NIE.

5. Their methodology "assumes that a sufficient number of reentry vehicles (RV) carrying warheads will be targeted on each silo so as to assure a 75 percent probability of destruction". The number of RVs targeted on each silo is based upon the achievement of this 75 percent probability of damage and is not constrained by fratricide considerations as in the NIE. Hence, as the Soviet MIRVed ICBM force grows, this methodology would give the Soviets somewhat greater capability than illustrated in the NIE.

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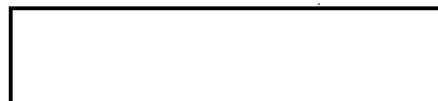
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6. To assess the vulnerability of the Soviet ICBM force, each of the 1300 Soviet silos is assumed to be hardened to withstand 3500 psi of overpressure. While this figure is consistent with the estimated hardness of the converted Soviet silos, we believe the Soviets will not increase the hardness of their entire force to that level until the mid 1980s. Hence, we evaluate current Soviet ICBM vulnerability using a much lower figure (around 1,000 psi) for most of the force--only 504 silos are estimated to be converted by 1 July 1978.

7. Because it takes, for example, 9 Minuteman RVs to achieve a 75 percent probability of damage against a 3500 psi Soviet target, it would take the entire Minuteman III force to attack about 180 Soviet silos using this criteria. They use the entire US missile force of ICBM's and SLBM's to attack the Soviet ICBM force and there is no residual missile capability.

8. Because US bombers are not considered in the analysis and because all US missiles are used in attacking Soviet silos, this study would tend to suggest that there would be no capability remaining to the US following a first strike against the Soviet land-based force. Hence, it would appear to contradict the results presented by the DCI. Their allocation, however, is unrealistic in evaluating residual capabilities.

9. There are a number of differences in the characteristics of both US and Soviet weapon systems which would cause different results even if the same methodology were used. For example, this study used a CEP of 0.10 nm for the improved Minuteman III while 0.12 nm was used in the NIE calculations. Similarly, a yield of 290 kt was used for the SS-19 Mod 2 rather than the NIE best estimate of 700 kt. On balance, however, it is the methodology, the exclusion of bombers, and the use of the entire Soviet ICBM force at the converted silo hardness figure that cause the inconsistency between the NIE and this study.



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should direct attention to the substance of these measures. They will be controversial even then, but the debate can center on what I am proposing rather than my supposed political motivation in proposing it.

Underlying these issues, incidentally, is the widespread belief that everything a politician does is self-serving. It is my belief that most politicians—even those with whom I almost always disagree—generally do what they think is right and in the best interest of their constituents.

The Watergate affair seems to have changed a healthy American skepticism for politicians into an unhealthy cynicism. This will not serve the Republic well in the long run.

Also, on a philosophical note; When Eric Sevareid retired from CBS he urged journalists to "not underestimate the intelligence of the audience and not overestimate its information." It's an excellent concept for politicians too.

The average citizen, occupied with earning a living and a host of matters affecting his daily life, cannot learn all the complex details of all the issues that we are elected to spend full time learning about. But that lack of information often leads people to ask for faster, simpler answers than can be found.

I used to believe in simple answers too. But the longer I have served the more I become convinced there are no easy solutions to complex problems. And most of our problems are complex.

It took we human beings many thousands of years to create some of these problems. It took death, wars, prisons, child abuse, poverty, ignorance, famine, prejudice, hatred, insecurity and a lot of other things to spawn most of our problems. We're simply not going to develop effective solutions to them overnight.

Yet, when people are hurting, when they are angry, when their futures are jeopardized, perhaps they need a leader who can more easily share their desire for ready, easy answers. Dealing with slow, difficult and complex solutions rarely meets the demands of an impatient society; be it blacks burning the cities or fishermen denied the right to fish or farmers demanding 100 percent of parity—now.

But then, being the patient counselor may well be the role of the philosopher, the priest and the teacher—not the politician.

Finally, let me say that I understand better today than I did 15 years ago when I first ran for office the attitude of Thomas Jefferson: that elective office is a gift the people give you, not the other way around. Being Congressman for the people of the Second District of Washington has been an experience so rewarding, so challenging and, overall, so gratifying that I sometimes wonder that a young man from Monroe really made it.

I will cherish this gift—the opportunity to participate in some of the great decisions of our times—all my life.

AMERICANS BURIED IN THE PANAMA CANAL ZONE

(Mr. ROBERTS asked and was given permission to extend his remarks at this point in the Record and to include extraneous matter.)

Mr. ROBERTS. Mr. Speaker, much has already been said about the proposed Panama Canal Treaty and there will be additional debate on the treaty within the next few weeks and months. I shall not dwell on the proposal except to say that I think it needs to be thoroughly reviewed and debated as there remain so many unanswered questions.

I am concerned about the disposition of two cemeteries in the Canal Zone, in which American veterans are interred. There are two American cemeteries within the zone—Corozal Cemetery on the Pacific side, and Mount Hope Cemetery on the Atlantic side. These cemeteries come within the jurisdiction of the Panama Canal Company, and according to the VA, they were initially established for the burial of employees of the Company. The Company is a corporate agency of the Government of the United States. It operates under the direction of a Board of Directors appointed by the Secretary of the Army. Management is by a staff comparable in selection and status to career personnel under the U.S. Civil Service and includes certain U.S. military officers assigned to the organization.

The mission of the Company is to "efficiently operate and maintain the Panama Canal as well as the business-type activities incidental to operations of the canal and to the Canal Zone Government."

Under the draft Panama Canal Treaty, the Corozal Cemetery would remain under U.S. control until the canal is completely returned to the control of the Government of Panama. The other, Mount Hope, would pass immediately to Panamanian control following ratification of the proposed treaty. I understand no provision was made in the treaty for maintenance or other disposition of Mount Hope.

Mount Hope contains the graves of 1,332 Americans, of whom 175 are veterans. It also contains the graves of 36,878 non-Americans, all of whom were involved in some way in the construction or operation of the canal since the canal operation began in 1903.

The Corozal Cemetery contains the graves of 741 veterans. In each cemetery the graves are not restricted to an area set aside for veterans, but scattered throughout the cemetery.

The Panama Canal Company has received several requests for the disinterment of remains for return to the United States. I am advised by the State Department and the Department of the Army that they are considering, on a preliminary basis, several alternatives. They are:

First. Negotiating an agreement with Panama wherein the Government of Panama would agree to continue and maintain these cemeteries.

Second. Authorizing the American Battle Monuments Commission to assume responsibility for maintaining the graves of the 1,332 Americans, buried in the two cemeteries.

Third. Enactment of legislation that would provide for the disinterment and reinterment, in a national cemetery in the United States at Government expense.

Mr. Speaker, it was aptly stated many years ago by a British Prime Minister, "Let me see the way a nation reveres its dead, and I will show you with a mathematical certitude the quality of civilization of that nation." We are now in

the process of ending over 74 years of official presence in the Canal Zone. One of the lasting memorials and reminders of that presence will be the cemeteries containing the graves of Americans, to which I have referred. While we must show proper reverence and respect to the graves of all Americans, I am particularly concerned about the future of the grave sites of the American veterans interred in these cemeteries. While these cemeteries are not in the United States, they nonetheless are a piece of America which will be a perpetual monument to those who served our Nation during the years of our exclusive operation of the canal.

These cemeteries must not be permitted to deteriorate, the graves must not be allowed to be desecrated, especially those who served in our Armed Forces. I have always been strongly committed to the principle that proper respect and honor shall be provided to veterans wherever they may be buried. The fact that these veterans' graves are far from their original homes in the United States should be the basis for a redoubling of our efforts to assure that the cause for which these veterans served in our Armed Forces shall live and that their grave sites will represent our Nation as a proud remembrance of their contribution to this great Nation and the successful operation of the Panama Canal during a crucial period of American history.

I have asked the chairman of our Subcommittee on Cemeteries and Burial Benefits to schedule early hearings on this matter so that we can be sure the remains of Americans buried in the Canal Zone shall not be desecrated and will continue to receive the same care and respect as presently prevails.

The SPEAKER pro tempore, (Mr. MOFFETT). Under a previous order of the House, the gentleman from New York (Mr. STRATTON) is recognized for 10 minutes.

Mr. STRATTON. Mr. Speaker, the adequacy of America's strategic nuclear deterrent force is always a matter of major importance, but especially now with negotiations underway in Geneva looking toward a SALT II Treaty that could impose new restraints on strategic nuclear forces, both American and Soviet.

Accordingly the questions recur: What is enough when it comes to such forces? Do we presently have enough? What impact will the new SALT agreement, as reported in the press, be likely to have on whether we can count on having enough in the future?

Dealing with such questions is difficult because there are many different opinions, and people adhere to them with considerable vehemence. The "hawks" say we do not have enough, and that our deterrence vis-a-vis the Soviets needs improvement and reinforcement. The "doves" say we not only have enough but perhaps more than enough, so that we can safely cut back our existing nuclear forces.

Those who support this latter position point out that while the Soviets may exceed us in total throw weight and in the

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yield of many of their missiles, we have more individual warheads and hence are at the very least in a position of "rough nuclear equivalence" with the Russians.

Some of those who argue this way also espouse the view—expressed on occasion by both Mr. Warnke and Dr. Kissinger—that in such matters there is such a thing as "minimum deterrence," and that once a nation has achieved a position of minimum nuclear deterrence there is no additional advantage to be gained from increasing nuclear weapons. In other words, nuclear "superiority" is meaningless, and numbers added beyond a certain point represent no increased deterrence.

In sharp contrast was a recent statement by Mr. Paul Nitze, confirmed to some extent by top Pentagon officials, that at some point in the 1980's U.S. land-based ICBM's will become vulnerable to a Soviet first strike. If his statement is true, it is most disturbing, and those of us in Congress charged with providing for the common defense have an urgent obligation to determine its truth or falsity.

Accordingly, I requested the staff of the House Armed Services Committee to analyze Mr. Nitze's charge and advise me whether his contention could be supported by fact. How can we know whether the Soviets can knock out most of our land-based ICBM's in the 1980's? Can we demonstrate the truth of such a proposition in terms that can be clearly and simply presented to the average citizen?

Too much of the discussion about nuclear weapons must be carried on behind closed doors and in classified documents. I insisted, therefore, that our staff give me the facts about the alleged vulnerability of our land-based ICBM force in unclassified form, if available, so that the full story on this obviously highly important issue could be made public.

The attached document is the report provided to me in response to that request. It is a sober and disturbing study and deserves, in my judgment, to be read and understood by every American. So far as I am aware this is the first time this particular issue has ever been presented in unclassified form and supported by specific numbers.

This unclassified assessment was made possible by virtue of the fact that there appeared in the CONGRESSIONAL RECORD for September 20, 1976, an article by Representative THOMAS J. DOWNNEY, Democrat of New York, containing a full table of Soviet nuclear missile numbers and types, together with their yield and a measure of their accuracy. This table forms the basis for the committee staff's conclusions. Since Mr. Downney has been a staunch advocate of the adequacy of America's present nuclear force his figures must be assumed not to be weighted in the direction of making Soviet capabilities look more impressive than they actually are.

In this connection, let me make it clear that while we accepted Mr. Downney's figures on those items which would be classified in any official Department of Defense study, we did not necessarily accept the Downey chart's estimates on those items that do not involve hard in-

telligence but only personal estimates as to the time at which the Soviets can be expected to make certain improvements in their nuclear capabilities.

For example, the drafters of the Downey chart have almost uniformly assumed that the Soviets will not have until the "late 1980's" certain capabilities which General Brown, chairman of the Joint Chiefs of Staff, indicated in his defense posture statement submitted to the Congress last January, indicated very clearly they were likely to have by the early 1980's at the latest.

We have felt it more prudent to accept the best estimates of the Chairman of Joint Chiefs of Staff on these key military matters rather than those of the drafter of Mr. Downey's chart.

Briefly, the study reaches the following conclusions:

First:

It can be concluded that by 1980 or 1981, depending upon Soviet reentry vehicle (RV) warhead yield, 12 percent to 60 percent of the land-based U.S.S.R. reentry vehicles could kill at least 75 percent of the U.S. silos—790. This would leave thousands of RV's for other targets.

Second:

It can be concluded that through 1980, if 4,285 U.S. RV's (100 percent of the U.S. land and sea-based ballistic missile forces on alert) were dispatched against U.S.S.R. silo targets, as many as 15 percent—209 out of 1,300—Soviet silos might be destroyed.

Third:

By the mid 1980's U.S. silo kill capability could reach as high as 65 percent "only if the 550 Minuteman III missiles are upgraded in accuracy and yield per current U.S. Air Force plans."

Fourth:

U.S. sea-based Poseidon nuclear missiles (SLBM's) do not have either the accuracy or yield to be Soviet ICBM "silo-busters."

Fifth:

Even if the projected Air Force program of improving the accuracy and yield of our Minuteman III force is carried out, that force "would remain vulnerable to a first strike . . . unless a silo-hardening program or some alternate basing scheme (such as the mobile MX) is pursued, at great cost."

Sixth:

The Soviet Union has used the very liberal (to them) SALT I provisions to achieve a position of numerical parity and a position of superiority with respect to throw weight and warhead yield.

Seventh:

Considering the asymmetry which will exist between the Soviets and United States forces, current SALT II negotiations "which center around reductions in the total numbers of missiles and the number of missiles with MIRV capabilities" . . . are "meaningless" . . . "without any concurrent consideration of weapon yields and accuracy, as well as throw weight . . ."

Eighth:

Without some verifiable limitation on yields and accuracy, any limitations on missile flight testing and nuclear warhead testing [as recently proposed by the USSR] can only freeze the United States into a posi-

tion of strategic inferiority—a condition which can only grow worse if an agreement is observed by the United States, but not by the Soviet Union.

One other observation is necessary. Those who argue that when it comes to nuclear deterrence numbers are meaningless—and that any country is fully protected against a nuclear attack, even a first strike, so long as it has a "minimum deterrent" capability—may argue that although the Soviets have the capability of knocking out much of our land-based ICBM force, they would never exercise that capability in practice. Why? Because our submarine missile force would still be intact and with it we could deliver devastating counterblows against Moscow and other major Soviet cities.

But this argument overlooks one significant fact spelled out in the study, namely, that even after a postulated Soviet first strike wiping out a sizable portion of our land-based ICBM forces, the Soviets would have thousands of nuclear reentry vehicles left over. Since, as this study has explained, U.S. SLBM's do not have either the yield or accuracy to knock out these remaining Soviet ICBM's, their retaliatory capability could only be directed against Soviet cities and industrial targets.

To be sure, in that mode they could still deliver considerable devastation to many parts of the Soviet Union. But because the Soviets would still have thousands of warheads available, a decision on our part to launch an SLBM retaliatory attack would in all probability be followed by an immediate counterattack against our cities. Under those circumstances, therefore, a decision to launch American SLBM's would, as a practical matter, amount to a decision to wipe out our own principal cities. Hence any rational American leader would obviously think twice before launching these SLBM's. In fact, once the full consequences were understood, those SLBM's would almost certainly not be launched at all.

Of course, this failure to launch would amount in turn to a surrender to the Soviets because of their superior remaining nuclear capability. In other words, with a vulnerable ICBM force and an SLBM force incapable of silo-busting, the United States would in fact not have a nuclear force capable of deterring a Soviet first strike. Clearly that is not an adequate deterrent.

One unidentified U.S. official expressed it graphically in Aviation Week and Space Technology for November 7, 1977:

A credible deterrent only exists on the basis of assured retaliation if an aggressor disarms himself in the process of aggression and knows the U.S. would respond with nuclear weapons. Having expended strategic weapons in a first strike, the aggressor would be powerless to shoot back when the U.S. retaliated. But that is no longer true today. If the U.S. responds, it must worry about the large and growing reserve force of Soviet strategic weapons.

This is the serious, sobering truth which the attached study brings out, and to which the American people and the Congress must promptly address themselves. Moreover, these conclusions must

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be fully understood and pondered before Congress agrees to any strategic arms limitation agreement that would freeze America permanently into such a dangerous and devastating nuclear inferiority.

Under leave to extend my remarks, the study referred to above follows:

STRATEGIC MISSILE COUNTERFORCE CAPABILITY
UNITED STATES VS. THE SOVIET UNION

QUESTIONS

Does the United States now possess a secure and survivable land-based intercontinental ballistic missile deterrent?

Could the United States, even in a first strike situation, destroy the land-based intercontinental ballistic missile capability of the Soviet Union in order to prevent a retaliation by those forces?

Could the Soviet Union, in a first strike situation, destroy the land-based intercontinental missile forces of the United States so as to prevent a retaliation by those forces?

SUMMARY

This study shows that the land-based intercontinental ballistic missile (ICBM) forces of the United States are vulnerable at this time and that they will become more vulnerable within the next four to five years as the accuracy of the Soviet ICBM's improves. A careful analysis shows that, if the entire available force of ICBM's and sea-launched ballistic missiles (SLBM) of the United States were to be targeted on 1,300 silos considered to be operational within the Soviet Union, at best about 16 percent of the Soviet missile silos would be put out of action by current U.S. systems. This percentage could increase to 68 percent by the 1980's only if the 550 MINUTEMAN III missiles are upgraded in accuracy and yield per current U.S. Air Force plans.

Conversely, the study shows that due to the high yields of Soviet missile warheads and the lack of sufficient hardening of the silos in the United States, the Soviet Union could put out of action a large fraction of all United States land-based ICBM's and still have a considerable percentage of its land-based missiles and all of its sea-based missile forces available for other targets.

The study assumes that a sufficient number of reentry vehicles (RV) carrying warheads will be targeted on each silo so as to assure a 75 percent probability of destruction. Improvements in Soviet missile accuracy, as was announced recently by the Secretary of Defense, (and the deployment of their missiles at a rate of 100 and 150 a year) could be used to either increase the probability of destruction of U.S. missile silos above 75 percent, or to target other U.S. assets.

All of the data used in this study are from unclassified sources. A major source was the CONGRESSIONAL RECORD of September 20, 1976, pages S16210-16218. Tables III and IV of that reference included the data used in this analysis on the number of reentry vehicles per missile, warhead yield, system accuracy, availability, and reliability.

THE CONCEPT OF COUNTERFORCE

Counterforce as a deterrent envisions the targeting of the nuclear strike forces of a potential enemy in order to destroy those forces and prevent an attack, or to limit the enemy's ability to retaliate with unacceptable force. Several scenarios are obvious within the concept of counterforce. One obvious scenario is that the Soviet Union might launch a massive surprise attack aimed at the destruction of the United States' ICBM and manned bomber forces. In a "worst case" situation, Soviet planners might calculate that such an attack could destroy the land-based portion of the U.S. deterrent along with a part of the manned bomber leg of the

triad. In such a case, the Soviets might be willing to absorb an attack by less accurate and lower yield sea-launched missiles and by penetrating bombers which might escape the Soviet antiballistic missile and air defense systems. If the United States were to receive sufficient warning, and if all United States ICBM's were fired on warning at the Soviet Union, the Soviet missiles would, of course, fall upon empty holes. In such a case, some portion of the missiles of the United States would also fall upon empty holes and some upon the Soviet missiles retained in reserve.

Various scenarios can be conceived where only a limited number of missiles are fired at a limited number of targets. Because of the many variables and unknowns involved, an analysis of what could happen in each and every possible scenario is impractical. This study examines the overall capability of United States strategic missile systems to destroy hardened Soviet silos and the capability of the Soviets to destroy hardened United States silos. A first strike is assumed in both cases.

EFFECTS OF WEAPONS ON SILOS

A great deal of information has appeared in the public press concerning the effects of nuclear weapons on "soft" targets such as cities and industrial sites. However, very little information has appeared concerning weapons effects upon hardened underground targets such as missile silos.

There are several ways to destroy a silo—by crushing it with sufficient overpressure, by creating a crater, or creating enough ground motion. Crushing requires the creation of peak overpressures of thousands of pounds per square inch (PSI). Cratering, on the other hand, by the explosion of a nuclear weapon close to the ground, can dig out or rupture silo walls or bury the silo headworks under the tons of debris ejected from the crater.

The distance from the target which a weapon must be detonated in order to create sufficient overpressure and/or cratering is known as the weapon's lethal radius. In the past, the overpressure effect has had the larger lethal radius. However, as silos have been increasingly hardened, cratering phenomena have become more important; and for this reason, the accuracy of missile systems in relation to the weapon's explosive power, or yield, has become more important. A weapon with very good accuracy relative to other missiles may not damage a hardened silo because its low yield may not provide a large enough lethal radius. On the other hand, a relatively inaccurate missile with a high yield may destroy a hardened silo because of its large lethal radius. The September 20, 1976, CONGRESSIONAL RECORD insert refers to new or refurbished Soviet silos which are hardened to 3500 PSI. A few examples with respect to the effect of nuclear explosions on targets of that hardness may, therefore, be useful.

A 1 kiloton (KT) nuclear explosive detonated on a relatively flat surface will produce a peak overpressure of 3500 PSI at 95 feet. A 40 kiloton explosion produces 3500 PSI at 320 feet, while a 900 kiloton (9 megaton) explosion produces the same overpressure at 1917 feet. Where overpressure is concerned, therefore, a 9 megaton weapon can be about 6 times less accurate than a 40 kiloton weapon and create roughly the same degree of damage.

Cratering phenomena vary according to the ground in which a silo is built. Data are available on hard rock, soft rock, and ordinary soil, either wet or dry. A silo can be rendered inoperable by cratering by a 1 kiloton explosion at about 50 feet in dry hard rock due to rupturing and/or burial. An explosion of the same size can destroy the silo out to 80 feet in wet soil or wet soft rock. The lethal radius from cratering doubles with

a 10-fold increase in the explosive yield. For example, 1 kiloton creates a crater with a radius of 60 feet in dry soft rock, while it would require a 10 kiloton explosion to create a crater with a radius of 120 feet in the same geological material. Ejected material causes a significant mound of debris around the crater, usually at a distance which is 25 percent greater than the crater radius.

The lethal radius for cratering and burial doubles with a 10-fold increase in explosive power, while overpressure will double with an 8-fold increase in yield. This would indicate that with current and predicted silo hardness, and with published system accuracies, overpressure will be the major factor in silo destruction. As system accuracy improves, however, the silo will be within the crater generated by a surface burst, thereby providing two lethal mechanisms. For the remainder of this report, only the effects of overpressure will be considered.

The following table indicates lethal radius doubling for an 8-fold increase in yield—1 KT vs. 8 KT vs. 64 KT. It also indicates the scaling factor and 3,500 PSI lethal radius for certain nuclear weapon yields attributed to Soviet and U.S. ballistic missile systems.

EFFECTS OF WEAPONS ON SILOS

Yield (kiloton)	Scaling Factor	3,500 p.s.i. radius (feet)
1	1.00	95
8	2.00	190
40	3.38	320
64	4.00	380
100	4.57	435
170	5.45	515
350	6.91	655
600	8.26	785
1,000 (1 MI)	9.77	930
4,000 (4 MI)	15.83	1,500
9,000 (9 MI)	20.18	1,920
25,000 (25 MI)	28.27	2,685

* 1,000 kilotons is generally referred to as a megaton (MI).

The scaling effect of overpressure makes the accuracy of delivery systems a key factor in silo destruction or incapacitation. For instance, a 1 kiloton explosive has an overpressure of 3500 PSI at 95 feet; this peak overpressure falls to 400 PSI at 200 feet. On the other hand, had the explosion occurred 70 feet from the target, the peak overpressure at the target would have been 10,000 PSI.

Strategic missile system accuracy (sometimes expressed as inaccuracy) is given in terms of the circular error probable (CEP) for each delivery system. The CEP is defined as the radius of a circle within which 50 percent of all missiles aimed at the center of the circle will impact. The other 50 percent will impact beyond that radius. It follows, therefore, that if a warhead (RV) has a lethal radius equal to its CEP, one-half of the time it is fired at a target it would be sufficiently close to kill the target. If the lethal radius of the warhead is smaller than the warhead's CEP, then the probability of a target kill by the warhead is less than one-half. For weapons having a larger lethal radius than their CEP, the probability of a target kill is increased accordingly. For this reason, it is necessary to compute the single shot kill probability (SSKP) for each system. This determination is necessary in order to assess the relative capabilities of strategic missile systems. In many cases, several RV's must be assigned to each hardened target in order to attain a desired probability that the target will be destroyed or disabled. Some of these RV's simply make up for the non-perfect reliability of each of the system, provided they come from different missiles. When one warhead does go off near another warhead, the first may destroy the subsequently arriving one. This phenomenon is known as fratricide. This paper will ignore

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this possible fratricide. Because the values of destruction achievable by the Soviets depend less on multiple RV attacks of single targets than does that of the U.S. this approximation will overstate U.S. capability much more than that of the Soviets. It should be borne in mind, however, that the targeting of more than 3 RV's on a target is highly impractical.

U.S. STRATEGIC MISSILE SYSTEMS VS. U.S.S.R. STRATEGIC MISSILE SYSTEMS

The CONGRESSIONAL RECORD article, cited earlier, gives all the parameters needed to develop single shot kill probability (SSKP) values for each system of both nations. The SSKP is most readily determined using special circular slide rules. For those interested in calculating SSKP values, Appendix I lists the slide rule designers. The appendix also provides the necessary equations and charts to develop the SSKP values mathematically.

Two assumptions have been made in determining whether the U.S. or U.S.S.R. or neither, has an edge in silo destruction. The first assumption is that the new Soviet ICBM missiles—the "Fourth Generation" which Secretary Brown described recently—will be housed in the best silos available. These can be hardened to 3500 PSI, as indicated in the CONGRESSIONAL RECORD article. Second, the United States appears to have no plans to build new silos or install a new missile system, with the possible exception of MX. U.S. silos, therefore, are probably in the hardness range of 1000 PSI to a maximum of 2000 PSI.

To attain a desired level of probability that an attacked silo will be destroyed can require that one or many weapons be targeted on that silo. The number of weapons required is related to the single shot kill probability and the desired confidence level. Computational procedures are explained in Appendix I.

For this report, an expected kill level of 75 percent has been chosen as representative and reasonable. Table I indicates the SSKP—single shot kill probability—of killing a Soviet silo hardened to 3500 PSI. Using POSEIDON as an example, note that its SSKP is 2 percent. This is the result of a low yield warhead and a large circular error. As a consequence, it would require 35 RV's to provide 50 percent assurance of killing one silo. This huge number indicates that POSEIDON cannot be categorized as a "silo buster."

Table II considers projected numbers of missiles, RV's, availability of the system to be on an alert status and system reliability—its ability to get to the target. Using TITAN II as an example, note that 46 of the RV's, with 9 megaton warheads, are available to be targeted. However, because of its large CEP, 3040 feet and reliability of 0.8, it requires 5 RV's to achieve at least the desired 75 percent probability of destruction of one 3500 PSI silo. Therefore, with 5 RV's per the target, the entire TITAN II force would be expected to kill only 7 silos.

Footnotes 3 and 4 of Table II indicate that the total U.S. MIRV'd force is below the 1320 total allowed under SALT I Table II

also assumes that the MINUTEMAN III is significantly upgraded from a current SSKP of .11 percent to MM III/MK 12A with a SSKP of 55 percent. If these qualitative changes are not made, it is obvious that the U.S. silo kill capability will remain closer to the 200 value than the 800 value attributed to the 1980's force.

Table III is the projected Soviet land-based ICBM capability against U.S. silos, using the CONGRESSIONAL RECORD article values. It should be clearly understood that, according to Secretary Brown's remarks about the new Soviet ICBM systems, these systems will be in place in the very early 1980's.

Table III projects the number of RV's, of different assumed yields, that would be required to achieve a 75 percent probability of destroying a U.S. silo hardened to 1000 PSI and to 2000 PSI. Note that above 4 megatons, at the assumed CEP, only one RV is required per silo.

The U.S. has 1054 silos. Table IV indicates the number of Soviet RV's that would be required to destroy 75 percent of these 1054 silos. If the RV's contained warheads from 300 kilotons up to 4000 kilotons—4 megatons. It should be recalled that the Soviets are given credit for having single RV missiles with warheads up to 25 megatons and MIRV'd missiles with warheads up to 9 megatons.

Under the limits of SALT I, it is assumed that the Soviets have 1300 silos. With SS-17, SS-18, and SS-19 systems in place, this could represent 7,000 or more MIRV's, in fact these systems do or can carry 6 to 8 RV's. These warheads, however, according to the CONGRESSIONAL RECORD table, would be in the megaton and below range.

The answers to the questions posed at the beginning of this study appear to be as follows:

The land-based intercontinental ballistic missile (ICBM) deterrent of the United States is vulnerable to a surprise attack by high-yield Soviet ICBM's. Vulnerability will increase as new and more accurate Soviet missiles are deployed.

Current U.S. ICBM and SLBM forces constitute only a 16 percent threat against Soviet hardened ICBM sites. This threat can be increased to 65 percent only if MINUTEMAN III missiles are upgraded in accuracy and yield. Unless a U.S. silo-hardening program or some alternate basing scheme is pursued, at great cost, the upgraded MINUTEMAN III force would remain vulnerable to a first strike.

Given a scenario wherein warning times are insufficient, or where there is a breakdown in command, control and communications, where U.S. ICBM's were not fired on confirmed attack, Soviet ICBM forces in the early 1980's could destroy all U.S. ICBM's in a first strike with a high degree of confidence.

If the objective of the United States is to maintain a credible deterrent and strategic stability, Soviet improvements in missile accuracy must be countered. Further hardening of U.S. silos may not be the answer

because of cost of survivability reasons. The most reasonable means to accomplish these ends is probably to develop accurate mobile missiles with sufficient yields. Some such multiple alpoint basing scheme would cause the Soviets to expend very large numbers of RV's targeted at many different alpoints in order to be sure of getting one RV onto a U.S. ICBM.

The relative positions of the United States and the Soviet Union with respect to ICBM's, and other nuclear forces, brings into serious question several aspects of the ongoing SALT II negotiations. It is acknowledged in most quarters that the Soviet Union has used the very liberal (to them) SALT I provisions to achieve a position of numerical parity and a position of superiority with respect to throw weight and warhead yield.

Current SALT proposals center around reductions in the total numbers of missiles and the numbers of missiles with MIRV capabilities. Closely related to numbers limitations are proposals to limit missile flight testing and the testing of nuclear warheads. Considering the asymmetry which will exist between the Soviet and United States forces, negotiations on the basis of numbers without any consideration of weapon yields and accuracy, as well as throw weight, are meaningless.

Without some verifiable limitation on yields and accuracy, any limitation on missile flight testing and nuclear warhead testing can only freeze the United States into a position of strategic inferiority—a condition which can only grow worse if an agreement is observed by the United States, but not by the Soviet Union. Such agreements would be not only imprudent, but they would also be contrary to national policy as expressed in Public Law 92-448 which, "... urges and requests the President to seek a future treaty that, inter alia, would not limit the United States to levels of intercontinental strategic forces inferior to the limits provided for the Soviet Union." (Emphasis added)

CONCLUSION

It can be concluded that through 1980, if 4285 U.S. RV's (100 percent of the U.S. land- and sea-based ballistic missile forces on alert) were dispatched against U.S.S.R. silo targets, as many as 15 percent—209 out of 1300—Soviet silos might be destroyed. By the mid-1980's, U.S. silo kill capability could reach as high as 65 percent if the MINUTEMAN III missile system is upgraded.

It can be concluded that by 1980 or 1981, depending upon Soviet RV warhead yield, 12 percent to 60 percent of the land-based U.S.S.R. RV's could kill at least 75 percent of the U.S. silos—790. This would leave thousands of RV's for other targets.

Public Law 92-448, 92nd Congress, H.J. Res. 1227, September 30, 1972. Joint Resolution: Approval and authorization for the President of the United States to accept an Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures With Respect to the Limitation of Strategic Offensive Arms.

TABLE III.—U.S. MISSILES

Missile	Numbers to be operational	Throw-weight (pounds)	Availability (percent)	Reliability (percent)	RV's per missile	Yield per RV (MT)	AMTE per RV	Countervalue		Countersilo		
								Operational missiles required for 200-400 AMTE deliverable	Inaccuracy (am)	Lethality (per RV)	Theoretical kill probability (percent)	USSR silos surviving attack (percent)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Present:												
Titan II	54	7,000	85	80	1	9	1.93	153-306	0.3	17	73	98
Minuteman II	450	2,000	90	85	1	2	1.23	212-242	3	18	71	83
Minuteman III	550	2,400	96	90	3	.17	.59	128-256	2	7	37	66
Polaris A-3	160	1,500	53	95	1	.5	1.01	379-757	.5	4	25	99
Poseidon	496	3,000	53	98	10	.04	.38	111-222	.3	1	7	90
												Target silos 500 p.a.i. ²

Footnotes at end of table.

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TABLE III.—U.S. MISSILES—Continued

Missile	Numbers to be operational	Throw-weight (pounds)	Availability (percent)	Reliability (percent)	RV's per missile	Yield per RV (MT)	AMTE per RV	Countervalue	Countersilo			
								Operational missiles required for 200-400 AMTE deliverable	Inaccuracy (nm)	Lethality (per RV)	Theoretical kill Probability (percent)	USSR silos surviving attack (percent)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Early 1980's: ²⁰												
Target silos 1,000 p.s.i.												
Minuteman III, Mk. 12A	550	2,400	98	90	3	.35	.73	106-212	.1	45	.83	19
Trident I, 4,500-nm. range ¹	* 768	3,000	66	90	8	.1	.50	82-165	.25	3	.12	77
Target silos 3,500 p.s.i.												
Late 1980's:												
M-X, Mk. 12A ¹	450	11,000	98	98	14	.35	.73	23-46	.1	49	.62	.17
M-X, MARV ¹	550	11,000	98	98	7	.1	.50	59-118	.02	538	.99	.1
M-X, Countervalue ¹	550	11,000	98	95	31	.1	.50	15-30	.1	22	.28	.73
Trident II, 6,000-nm. range	* 336	6,000	66	95	14	.15	.57	36-73	.3	3	.5	.91
Trident II, MARV, short range	(*)	8,500	66	95	14	.04	.38	54-109	.02	292	.96	.1
Trident I, MARV, short range	(*)	3,500	53	95	7	.04	.38	146-292	.02	292	.96	.7

TABLE V.—U.S.S.R. MISSILES

Missile	Numbers to be operational	Throw-weight (pounds)	Availability (percent)	Reliability (percent)	RV's per missile	Yield per RV (MT)	Countervalue		Countersilo			USSR silos surviving attack ² (percent)
							AMTE per RV	Operational missiles required for 200-400 AMTE deliverable	Inaccuracy (nm)	Lethality (per RV)	Theoretical kill Probability (percent)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Percent: ²⁰												
SS-9	306	12,000	85	80	1	.25	3.62	81-162	.7	17	.66	87
SS-11 ¹¹	1,000-1,050	2,000	85	75	1	.1	1	313-626	1.0	1	.6	96
SS-N-6	750-950	2,000	12	80	1	.1	1	2,000-4,000	1.0	1	.6	99
SS-N-8												
Target silos 650 p.s.i.												
Early 1980's:												
SS-18 ¹²	306	16,000	85	85	8	.67	.85	40-80	.25	12	.39	45
SS-19 ¹³	(17)	7,000	85	85	6	.29	.61	76-152	.25	7	.24	63
SS-N-7 ¹⁴	?	?	?	?	?	?	?	?	?	?	?	?
Target silos 1,000 p.s.i.												
Late 1980's:												
SS-18, Mk. 12A technology	306	16,000	85	85	8	1.38	1.14	30-61	.1	124	.86	.78
SS-19, Mk. 12A technology	(17)	7,000	85	85	6	.62	.82	56-113	.1	72	.71	.15
SS-N-7 ¹⁴	?	?	?	?	?	?	?	?	?	?	?	?
1990's:												
SS-18, MaRV ¹⁵	306	16,000	90	90	15	.2	.52	31-62	.02	855	.89	.1
SS-19, MaRV ¹⁵	(17)	7,000	90	90	7	.2	.52	67-134	.02	855	.89	.1
Trident II ¹⁶ equivalent, MaRV, short range	288(7)	8,500	.60	90	14	.0	.28	70-140	.02	292	.96	.2

FOOTNOTES TO TABLES III AND IV

¹ The effect of a single reliable RV upon a single silo.² Assumes the entire listed missile system is used in an attempt to destroy the entire enemy silo complex. 2 RV's per silo are used to the extent permitted by available numbers.³ Combined attack.⁴ A 3-unit nonindependently targeted MIRV, best visualized as a single RV with a triangular explosion.⁵ Aviation Week and Space Technology, Oct. 13, 1975, p. 17.⁶ Hypothetical but plausible countersilo-optimized configuration.⁷ Hypothetical but plausible countervalue-optimized configuration.⁸ 12 Trident ships with 24 missiles each plus 30 formerly-Poseidon ships with 16 missiles each.⁹ 14 Trident ships.¹⁰ Approximately 100 very old soft-tipped SS-7 and SS-8 ICBM's with 5MT yield, low accuracy, and dubious reliability are omitted for brevity since they are being retired and make no significant contribution to the counterforce/countervalue balance. Similarly, the approximately 60 SS-13's are omitted, as are the 21 SS-N-5 low-capability missiles.¹¹ A small number of SS-11's may be deployed as a 3-unit MIRV. This is omitted since it has no significant effect of force capability.¹² While the SS-18 has been tested as a MIRV, deployed versions reportedly use single warheads. I assume all will be converted to MIRV, since this gives higher capability for both countersilo and countervalue.¹³ Some of these missiles will probably be SS-17's, SS-16's, or MIRV SLBM's. The pure SS-19 force is assumed for simplicity and because it presents a worst-case situation in that it has higher countersilo and countervalue capability than the alternatives.¹⁴ I have no basis for predicting the nature of future Soviet SLBM's since they will probably differ significantly from the present rather primitive models. We can, however, assume that by 1980 Soviet SLBM's will possess countervalue sufficiency, and that they will not have a significant countersilo capability until terminal guidance is deployed.¹⁵ Replacing Trident II countervalue.¹⁶ Replacing standard Trident in Poseidon ships.¹⁷ SS-11 replacement.

TABLE I.—SINGLE AND MULTIPLE SHOT PROBABILITY OF DESTROYING A SILO HARDENED TO 3,500 p.s.i.

System	Yield (kilotons)	Lethal radius (feet)	CEP (feet)	Single shot P _k	Number of RV's for at least the desired kill probability		
					0.50	0.75	0.90
IN PLACE							
Poseidon	40	320	1,824	0.02	35	69	114
Polaris ¹	600	900	3,040	.05	14	27	45
SS-N-11	1,000	1,050	1,824	.22	3	6	10
SS-N-17	170	600	1,216	.15	5	9	15
SS-N-18	9,000	2,200	3,040	.30	2	4	7
1980'S							
SS-N-11/MK-12A	350	730	608	.65	1	2	3
Trident	100	450	1,520	.07	10	19	32

¹ Assumes yield from 3 RV's in a fixed triangular pattern.² Derived using the GE missile effectiveness calculator.³ Any number greater than 3 is highly impractical.

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TABLE II. OVERPRESSURE KILL OF SOVIET SILOS HARDENED TO 3,500 LB/IN

System	Number of missiles	RV's	Total RV's	Availability (percent)	Reliability (percent)	RV's available to target	Number of silos that can be attacked so that the probability of destroying each silo is at least 0.75
IN PLACE							
Titan II	54	1	54	0.85	0.80	46	9
MM-III	450	1	450	.90	.85	405	61
MM-III	550	3	1,650	.98	.90	1,617	170
Polaris I	160	1	160	.55	.95	88	3
Poseidon	496	10	4,960	.53	.90	2,629	35
Total	1,710		7,274			4,785	275
EARLY TO MID-1980'S							
MM-III/MK-12A ^a	550	3	1,650	.98	.90	1,617	1,026
Trident ^b	240	8	1,920	.53	.90	1,018	48
Titan II	54	1	54	.85	.80	46	9
MM-III	450	1	450	.90	.85	405	61
Poseidon	496	10	4,960	.53	.90	2,629	35
Total	1,790		9,034			5,715	1,179

^a Some tradeoff may occur between Polaris and Trident; Polaris is considered dropped by 1980's.

^b Only 1,206 are MIRVed.

^c Of these 275 silos, at least 206, or 75 percent of the Soviet silos, would be expected to be destroyed.

^d MM-III is expected to be converted to MM-III/MK-12A by mid-1980's.

^e Only 1,286 are MIRVed.

^f Of these 1,179 silos, at least 884, or 75 percent of the Soviet silos, would be expected to be destroyed.

TABLE III—SOVIET STRATEGIC MISSILE OVERPRESSURE KILL OF U.S. SILOS^a

Yield (kilotons)	1,000 psi			2,000 psi		
	Lethal radius (feet)	Single shot kill	Number of RV's to achieve 0.75 kill probability per target ^b	Lethal radius (feet)	Single shot kill	Number of RV's to achieve 0.75 kill probability per target ^b
300	985	0.35	4	788	0.29	6
1,000	1,500	.63	2	1,170	.50	3
2,000	1,840	.80	2	1,475	.65	2
3,000	2,105	.85	2	1,685	.80	2
4,000	2,315	.91	1	1,855	.82	2
6,000	2,650	.96	1	2,120	.90	1
9,000	3,030	.98	1	2,420	.95	1

^a Assumes Soviet ICBM systems CEP is 1,250 ft for each system. Assumes MIRVed warheads can have range of yields from 300 Kt to at least 9 Mt.

^b Reliability of .85.

TABLE IV—U.S.S.R. OVERPRESSURE KILL OF U.S. SILOS

U.S.S.R. RV yield	Number of warheads to attack 1,054 U.S. silos with 75 percent probability of destroying each ^a	
	1,000 p.s.i.	2,000 p.s.i.
6,000 Kt or higher	1,054	1,054
4,000 Kt or higher	1,054	2,108
3,000 Kt	2,108	2,108
2,000 Kt	2,108	2,108
1,000 Kt	2,108	2,162
300 Kt	4,216	4,324

^a Assuming a reliability of 0.85.

APPENDIX I

Circular slide rules

The General Electric (GE) Company's Heavy Military Electronic Systems Division developed a "Missile Effectiveness Calculator" which provides a means of quickly evaluating the effect of changes in various weapon system parameters on the performance of the system.

The Missile Effectiveness Calculator is used to show the lethal radius of a weapon when used against point targets of specified hardness, to convert this to single shot kill probability (SSKP) for a range of CEP's and to show the cumulative kill probability when more than one weapon is fired against a target.

The Rand Corporation has developed the "Damaged Probability Computer for Point Targets with P and Q Vulnerability Numbers." It is designed to aid military analysts and planners in making quick estimates of the expected outcomes of attacks against overpressure-sensitive targets (PVNs) and dynamic-pressure-sensitive targets (QVNs). It was prepared under the Project RAND

task entitled "Future Strategic Aerospace Force Requirements," a U.S. Air Force contract. Unfortunately, use of this RAND computer is somewhat restricted by the fact that the vulnerability numbers are in a classified Department of Defense document. However, reasonable results which match those of the GE calculator are obtainable if one assumes the peak overpressure hardness of a given target, and the yield of the weapon. Only the SSKP percent figure is obtained from the RAND computer.

Calculating SSKP and confidence level

To calculate SSKP, one must know the CEP and yield of the incoming weapon, and the hardness of the target. The lethal radius of the weapon is directly related to its yield and can be scaled from a one kiloton explosion. Following are one kiloton lethal radii for a range of silo hardness values.

1 KT Lethal Radius Table

PSI Hardness	Lethal Radius (FT)
500	190
650	170
1000	150
2000	120
2500	110
3000	101
3500	95
4000	91

Lethal radius increases (or decreases) as the 0.33 power of the weapon of interest compared to a one kiloton weapon. By equation:

$$\text{Desired lethal radius} = (1 \text{ KT lethal radius}) \times (\text{Weapon Yield})^{0.33}$$

This equation can be solved using logarithm tables or the Y^x or logarithm func-

tions available on most calculators. Knowing CEP and the lethal radius, one can calculate SSKP from:

$$\text{SSKP} = 1 - 0.5 \left[\frac{\text{Lethal radius}}{\text{CEP}} \right]^2$$

If one now includes system reliability, the probability, P_x , of one warhead destroying a target is then:

$$P_x = P(\text{SSKP})$$

When more than one weapon is fired at a target, the cumulative kill probability— $P_x(n)$ —can be obtained from:

$$P_x(n) = 1 - (1 - P_x)^n$$

where "n" is the number of weapons fired at the target from different missiles.

The number of weapons—n—to give the desired $P_x(n)$ is obtained from:

$$n = \frac{\ln [1 - P_x(n)]}{\ln [1 - P_x]}$$

Arithmetic calculation of values

If one does not have a hand calculator or logarithm tables, values of lethal radius, etc., can be derived arithmetically. It was pointed out that lethal radius doubles with an 8-fold increase in yield. The following table indicates the increase in lethal radius for increases in yield.

OVERPRESSURE SCALING TABLE

Increase in yield	2X	3X	4X	5X	6X	7X	8X
Increase in lethal radius	1.25	1.44	1.59	1.71	1.82	1.91	2.00
Proportional parts mid-point	(1.345)	(1.515)	(1.655)	(1.765)	(1.865)	(1.955)	

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Consider the following example. What is the lethal radius of a 16 KT weapon against a target hardened to 500 PSI? A 160 KT weapon against the same target? 1 megaton?

From the 1 KT Lethal Radius Table, 500 PSI is found to a distance of 190 feet. A yield of 16 KT is (8x2) the value of 1 KT. From the Overpressure Scaling Table, 8 = 2.00 and 2 = 1.25.

The lethal radius for a 16-KT weapon against a 500 PSI target is:

$$\text{Lethal Radius} = (190) (2) (1.25) = 476 \text{ feet}$$

For 160 KT, one finds the scaling value by dividing 160 by 8 until a number less than 8 results:

$$\frac{160}{8} = 20$$

$$\frac{20}{8} = 2.5$$

Each value of 8 doubles the lethal radius. Note that 2.5 is midway between 2x and 3x on the Overpressure Scaling Table. The lethal radius for a 160 KT weapon against 500 PSI is therefore:

$$\text{Lethal Radius} = (190) (2) (3) (1.25) = 1,022 \text{ feet}$$

One megaton would be:

$$\frac{1000}{8} = 125$$

$$\frac{125}{8} = 15.63$$

$$\frac{15.63}{8} = 1.95$$

The increase in radius provided by 1.95 can be determined by dividing it by the value for 2x or:

$$\frac{(1.95)}{(2.00)} = 0.975$$

$$\frac{(0.975)}{(2.00)} = 0.4875$$

The lethal radius for a 1-megaton weapon for 500 PSI is:

$$\text{Lethal Radius} = (190) (2) (3) (2) (1.22) = 1,854 \text{ feet}$$

It is assumed that system CEP is given. The SSKP can then be determined from the equation:

$$\text{SSKP} = 1 - 0.5 \left[\frac{\text{Lethal radius}}{\text{CEP}} \right]^2$$

Representative values of SSKP for various ratios of lethal radius to CEP follow:

SSKP percent	Lethal Radius CEP
1	0.12
10	0.39
30	0.71
40	0.86
50	1.00
75	1.40
90	1.84
95	2.10
99	2.60

The final parameter of interest, the number of weapons necessary to assure destruction at any given confidence level is derived from:

$$n = \frac{\log(1 - \text{desired probability of damage})}{\log(1 - \text{reliability times single shot kill probability})}$$

Some representative values are presented below, for a reliability of one:

n for given P _d	50 percent	75 percent	90 percent	95 percent
10	7	12	15	19
20	3	6	8	10
30	2	4	5	7
40	2	3	4	5
50	2	3	4	5
60	1	2	3	4
75	1	1	2	3

* Indicates n greater than 20.

STATE GRANTS FOR LONG-TERM CARE INITIATIVES

The SPEAKER pro tempore. Under a previous order of the House, the gentleman from Maine (Mr. COHEN) is recognized for 5 minutes.

Mr. COHEN. Mr. Speaker, I am introducing legislation today with my colleague on the House Select Committee on Aging, Chairman PEPPER, to set up a program of special grants to States to help meet the needs of this Nation's chronically ill and disabled elderly. We intend to offer this legislation as an amendment to the Older Americans Act when it is considered for reauthorization later this year.

The Older Americans Act—often thought of as our Magna Carta for the elderly—has catered mainly to the needs of these elderly citizens who are in good health. The health and social needs of the more than 8.5 million elderly who have chronic impairments have not received adequate attention under the Older Americans Act. While title III of the act calls for social services of many kinds, the delivery of these services has not been linked with the intensive medical services of other Federal programs to serve the needs of the aging. Instead, the existing service delivery system labels older people as either "healthy" and not in need of services or "sick" and needing institutional care.

As their disabilities increase, the elderly poor have no other place to turn but Federal programs. They find themselves either without help or placed in costly institutions. Institutional care is often not the best mode of care, but because financial alternatives to such care are not available, it becomes necessary. A study contracted by the Department of Health, Education, and Welfare in 1975 cited figures which draw attention to this problem. The study indicated that between 14 and 25 percent of the institutionalized elderly may not need that form of care.

Nevertheless, the need for some type of care is evident. The extent of chronic illness in the United States has been growing in direct relation to increases in life expectancy. The number of people 60 and older has increased more than 12 percent since 1970. This rate of increase includes those 85 and older who represent the fastest growing segment of our population. Their numbers have increased 39.6 percent during the same period. In raw numbers, the elderly total roughly 20 million persons, and almost one-fifth are limited in mobility, while over two-fifths are limited in activity by chronic disabilities. This is more than double the incidence of chronic disability in any other age group.

In the past, Federal programs have not fostered the interrelationships between social and medical services which are necessary to meet the needs of the chronically ill and disabled elderly. The needed steps have not been taken largely because of anticipated cost and proliferation and fragmentation of those service delivery efforts we do have.

The cost issue was highlighted last year when testimony was taken by the Subcommittee on Health and Long-term Care on the impact of Medicaid cutbacks on the elderly. The flexibility of Federal reimbursement policies make it impossible for States to control costs for services which account for the overwhelming portion of their Medicaid budgets. While only 5 percent of the Medicaid population reside in institutions, they account for approximately 40 percent of total expenditures under the program. States can only cut costs by eliminating outpatient, preventive services and reducing provider fee schedule allowances which would benefit the vast majority of the elderly with disabling chronic conditions who are not institutionalized. These cutbacks not only decrease the willingness of providers to serve the elderly poor, they also increase the likelihood that medical assistance will only be sought through expensive, inpatient means.

The evidence is growing that other forms of community support, such as home health and homemaker services, will better meet the needs of the chronically ill and disabled elderly at a lower cost per person. The GAO report concludes that "until older people become greatly or extremely impaired, the cost of nursing home care exceeds the cost of home care." This estimate of the cost of home care includes the value of general support services provided by family and friends. The Government has been reluctant to pick up the costs for these less intensive service delivery systems because they would greatly increase total Federal expenditures.

Proliferation and fragmentation in existing long-term care and social services are the other elements which frustrate the elderly in their quest for appropriate assistance. For example, more than a dozen programs, including Medicare, Medicaid, title XX social services and the Older Americans Act, provide long-term medical or supportive services for the elderly in their homes. Each of these programs has a different set of eligibility requirements and income limits, and often they are governed by conflicting regulations. No wonder it is a nightmare for the elderly individual trying to avail himself of his entitlements.

My bill begins the process of breaking through these barriers by granting States money to establish within communities "single entry point" programs for the entire range of medical and social services needed by the chronically ill and disabled elderly. These programs would be responsible for patient assessment, referral to the most appropriate level of care, and progress reporting.

PATIENT ASSESSMENT

The primary purpose of patient assessment is to improve patient care by determining the type and intensity of services needed. These services would be drawn from the services already authorized under title III of the Older Americans Act, emphasizing those designed to meet the diagnostic, therapeutic, re-